

Historic, archived document

Do not assume content reflects current scientific knowledge, policies, or practices.

U. S. DEPARTMENT OF AGRICULTURE.

FARMERS' BULLETIN No. 18.

FORAGE PLANTS FOR THE SOUTH.

BY

S. M. TRACY, M. S.,

DIRECTOR OF THE MISSISSIPPI AGRICULTURAL EXPERIMENT STATION.

PUBLISHED BY AUTHORITY OF THE SECRETARY OF AGRICULTURE.

WASHINGTON:
GOVERNMENT PRINTING OFFICE.

1894.

LETTER OF TRANSMITTAL.

U. S. DEPARTMENT OF AGRICULTURE,
OFFICE OF EXPERIMENT STATIONS,
Washington, D. C., May 22, 1894.

SIR: I have the honor to transmit herewith for publication as a Farmers' Bulletin an article on forage plants especially adapted to the Southern States. This article was prepared by Prof. S. M. Tracy, Director of the Mississippi Agricultural Experiment Station, who had charge of the experiments with forage plants carried on during the past five years by this Department in coöperation with the experiment stations in Mississippi, North Carolina, Georgia, Florida, and Louisiana. Over 500 native and foreign species of grasses and other forage plants were tested with special reference to their value for hay or pasturage. This bulletin summarizes the practical results of this investigation, and is confined to accounts of the species whose value for the agriculture of the South has been definitely established.

The illustrations were prepared under direction of Prof. F. Lamson-Scribner of this Department, some of them having been previously furnished by him to the publishers of Webster's International Dictionary, by whose courteous permission they are used in this publication.

Respectfully,

A. C. TRUE,
Director.

Hon. J. STERLING MORTON,
Secretary of Agriculture.

CONTENTS.

	Page.
Introductory.....	5
Forage plants for different soils	5
Yellow loam soils	6
Alluvial and river bottom soils	8
Black prairie soils.....	9
Pine woods soils	10
Formation and care of meadows and pastures.....	11
Preparation of the land.....	11
Time of sowing.....	12
Application of fertilizers.....	12
The forage plants successfully grown in the South	13
The true grasses—	
Japanese ryo grass.....	13
Redtop	14
Hungarian brome grass	14
Rescue grass.....	15
Orchard grass.....	15
Terrell grass.....	16
Teosinte	16
Bermuda grass.....	17
Perennial ryo grass.....	18
Guinea grass.....	19
Crab grass.....	19
Texas millet.....	19
Large water grass.....	20
Carpet grass.....	20
Timothy	21
Kentucky blue grass	21
German millet	21
Johnson grass.....	22
Leguminous plants—	
Cowpea.....	23
Lespedeza (Japan clover)	24
Alfalfa (lucerne)	24
Bur clover.....	25
Melilotus	25
Alsike clover.....	26
Crimson clover.....	26
Red clover	27
Hairy vetch.....	28
Mexican clover	29
Summary	29

FORAGE PLANTS FOR THE SOUTH.

The soil, climate, and conditions of the Southern States are so different from those of the North that different species of plants, as well as different methods of culture and treatment, are necessary to success in the making of meadows or pastures. The soil, although almost wholly of sedimentary formation, is exceedingly variable in character. Much of it has had nearly all of its vegetable matter exhausted by continuous cultivation in cotton. In many sections extreme care is necessary to prevent the washing of hillsides. Severe freezes are unknown, so that many of the more hardy plants continue their growth during the entire winter. On the approach of hot weather these plants disappear, and their places are filled by a rank summer growth of plants, many of which are too coarse and unpalatable to be of value for either hay or pasture. Although the growing season is almost continuous for some species, there are none which will make a vigorous growth throughout the year, so that permanent meadows and pastures can be made only with mixtures of several species which make their growth at different seasons.

Sufficient hay for home consumption may be gathered on almost any plantation without expense, except for the harvesting, but such crops are uncertain in amount, are usually inferior in quality, and are rarely such as will assist in preparing the soil for future crops. A good hay plant must not be too rank in its growth, or its stems will be coarse and woody; it must have a large proportion of leaves, which are the most edible parts of the plant; it should be easily cured when made into hay; and it must be nutritious, easily digested, and palatable. If wanted for a permanent meadow, the plant must be a perennial. As the true grasses are of but little value as fertilizers, it is important that, where the crop is to be grown as a part of a rotation, at least one of the species used in any mixture should be a leguminous plant; if the forage crop is to be grown one season only, leguminous plants are always to be preferred.

FORAGE CROPS FOR DIFFERENT SOILS.

No one grass or mixture of grasses will be found best for all localities, but the choice must be varied to meet local conditions. The character of the soil is the principal item to be considered in making a selection

for sowing. In the region covered by this work there are four types of soils, which embrace fully nine tenths of its area. These are (1) the yellow loam and clay uplands, (2) the alluvial river bottom lands, (3) the black prairie regions, and (4) the pine woods region. For each of these sections different species, different mixtures, and different modes of treatment are required; and this Department has made a special study of the requirements of each region.

YELLOW LOAM SOILS.

The yellow loam and clay uplands include a large part of North Carolina and the northern portions of Georgia, Alabama, and Mississippi. They are also found in northern Louisiana and in some parts of Texas, where they merge into the pine woods lands. The land in the western part of this region, from Mississippi to Texas, is mostly rolling and well drained, contains an abundance of lime, and is naturally very fertile, but often hard and compact, containing but little sand, and suffering severely from drought. In the eastern section the soil generally has less lime, is much lighter and more sandy, and so can be more easily worked. While the crop here is less in quantity than that from the bottom lands, it is superior in quality, being less coarse in fiber, richer in nutritive matter, and less mixed with weeds and coarse grasses.

Bermuda grass, Johnson grass, lespedeza (Japan clover), red clover, and melilotus furnish the principal hay crops of this region, and for a permanent meadow on rich soil Bermuda grass is undoubtedly the best species, though we have found no leguminous plant which is satisfactory for sowing on the same ground. Red clover is often sown on the same land with Bermuda grass, but as the two mature at different seasons, and as the clover is seldom permanent, the mixture can hardly be recommended. Bermuda grass meadows may be pastured through the winter without injury. Alsike clover adds greatly to their value at that time, and as it also increases to some extent the hay crop, it is perhaps the best of the family for sowing on Bermuda grass meadows. Johnson grass gives the largest yield, and if it were not for the ease with which it spreads to adjoining fields and the extreme difficulty with which it can be eradicated, we should recommend it highly. Melilotus is the best of the legumes for sowing with it, and as it increases the yield largely, makes the hay more palatable, and keeps the soil in better condition, it should be sown on all such meadows. When a crop is wanted to occupy the ground for two years only, red clover, as it yields well, should be sown on the rich soils that are in good condition, and in the South at the present time the hay sells better than that from any other crop. On the more sterile soils, which are not soon to be planted with other crops, lespedeza is perhaps the best plant which can be used, and on lands containing an excess of lime melilotus is the most profitable crop. When the land is to be used for only a single crop of hay lespedeza is the best for thin clay soils; while for fields in even fair

condition cowpeas will be found the most profitable; and on very rich soils German millet may be grown to advantage. For soiling, sorghum, soja beans, and beggar weed do well.

About 165 species of grasses are native to this region, and many of these furnish large amounts of hay. Several species of broom sedge, *Panicum*, and *Paspalum*, and many other native species abound on the uncultivated lands, and if cut sufficiently early, before the seed stems are grown, make hay of fair quality; though if allowed to grow until the seed is ripe, as is too often done, they are of but little value for hay, being tough, wiry, and unpalatable.

The natural pastures in this region are all that can be desired during the summer and fall months, but fail rapidly after the first heavy frosts, and do not become really good again until April. For making a permanent pasture Bermuda grass and lespedeza are the best foundation; and to these should be added orchard grass, Hungarian brome, and bur clover for the drier soils; while redtop, water grass, and alsike clover will be the best additions for the wet lands. White clover grows well on the uplands, and the Carolina and creeping clovers give rich grazing in March and April, but soon disappear. On the sandy and gravelly uplands, especially on the Atlantic coast, crimson clover gives excellent winter pasture, and under continuous grazing will reseed the ground so as to be practically permanent. Where crimson clover will not grow and the pasture is needed for immediate use, rescue grass, Terrell grass, and hairy vetch will make good winter pastures; and if stock be taken from the field in March or April these plants will reseed the ground for the following season, but they will soon disappear under continuous grazing.

One of the most common pests in the upland pastures of this region is the bitter weed (*Helenium tenuifolium*) which is eaten freely by cows in the absence of better herbage and which imparts a very disagreeable flavor to their milk. The presence of this weed is an almost certain indication that the soil is weak and thin, and that the land has been pastured too closely. Such pastures can be easily reenergized by resting and fertilizing, as the weed is never troublesome on lands which are rich and in good condition.

ALLUVIAL AND RIVER BOTTOM LANDS.

The river bottom lands are found along the courses of all the larger streams in the eastern section, and cover a large portion of western Mississippi, southern Louisiana, and eastern Texas. These soils are almost wholly of recent alluvial formation, are rich in humus, and usually contain an abundance of lime, together with more or less sand. Many of them are subject to overflows and nearly all of them suffer from want of drainage. Being more fertile than the uplands they produce larger crops of hay and afford a much wider range of choice in the selection of varieties.

For permanent meadows on these lands Bermuda grass, Johnson grass, redtop, alfalfa, and red clover all do well, though Bermuda grass and red clover have given the most general satisfaction. Of the true grasses, Bermuda grass makes hay of the best quality. Its yield is from 3 to 4 tons per acre in two cuttings, and it is not injured by short overflows. Johnson grass also yields heavily but it is more easily injured by water than is Bermuda grass, and the hay does not sell as well. Redtop bears a longer overflow than does either of the others, and we have found it advantageous to sow it on places where the others are liable to be drowned out, as it adds largely to the yield of hay and keeps down the growth of weeds and coarse grasses. Where the soils are fairly well drained red clover does well and is one of the best crops which can be grown, as the hay finds a ready market at good prices. On soils which have thorough drainage alfalfa makes a heavier yield than any other good hay plant, but it can not be grown profitably on heavy soils or where standing water comes near the surface. When a meadow is wanted for two years only, red clover is by far the best plant that can be used, while if but a single crop is to be cut, lespedeza is best, especially for the drier soils, in which it can be sown early; and for late sowing German millet has given the best results. For soiling crops we have found nothing better than teosinte, alfalfa, and soja beans.

It is comparatively easy to make good summer pastures with Bermuda grass and lespedeza on these lands, but in the winter the soil becomes so water-soaked and cold that it is difficult to find plants which afford good grazing during that season. In all these regions canebrakes are more or less abundant and furnish rich feed, but are usually so scattered that they can do little more than sustain life in the animals which range through them. Bermuda grass makes the best of summer pasture, but is killed to the ground by moderate frosts and so is of little value during the winter. Johnson grass lasts but a short time when pastured, and red clover is soon trampled out. Redtop is much more lasting and should be sown in every field intended for a permanent pasture. Alsike clover does well on these soils even when heavy and badly drained, and is the best of the family for winter grazing. Bur clover also does well, and alfalfa makes good winter pastures on sandy soils in the extreme South. Japanese rye and rescue grasses grow well where they are not subject to overflow, the former being the more permanent. Among the native sorts that can be grown here to advantage are the large water grass and Terrell grass, both of which grow during the cooler months and are unhurt by overflows. Carpet grass will make good winter grazing where the soil is dry and sandy. Where pastures are wanted for one season only we have found nothing better than a mixture of Terrell grass, perennial rye, and hairy vetch sown in August or September for winter use; with lespedeza, beggar weed, and Mexican everlasting grass for summer use.

The black prairie soils are found principally in western Alabama, eastern Mississippi, and eastern Texas, but though among the most fertile in the whole country they need peculiar treatment to make them productive. While ordinary commercial fertilizers and even liberal applications of stable manure produce little effect on them, the plowing under of an occasional green crop seems all that is necessary to keep them in a state of high productiveness. Most of these lands are quite level, are poorly drained, and remain wet very late in the spring, but pulverize readily when dry, even though they have been plowed while quite wet. They are rich in lime, and no better grass lands can be found.

For the production of hay alone, without regard to its effects on the soil, Bermuda is the best grass which can be grown as a permanent meadow. Under proper management, however, these lands are so productive for corn and cotton that most planters prefer to rest the fields with some crop which will give prompt returns in hay and which will at the same time prepare the soil for some future hoed crop. For this purpose, on these soils, there are no plants equal to melilotus and red clover, the former being the more valuable as a fertilizer, while the latter makes the better hay. On soils which contain an excess of lime, are badly drained, or are in poor mechanical condition melilotus will grow well, give fair returns in hay, and do more than any other plant to put the soil in good condition; while on the better soils red clover is more profitable for hay, and gives to the soil all the green manuring which it needs. Johnson grass also does well here, and a mixture of this grass with melilotus, recommended on another page, makes a heavy yield of excellent hay. Lespedeza grows well on the soils which are not too wet, and is perhaps the best hay crop which can be grown where the field is to be used for that purpose only one year. For a short-season hay crop to follow wheat, oats, or potatoes, either cowpeas or German millet should be used.

There is a variety of sorghum, commonly known as "chicken corn," which has become thoroughly naturalized on the black prairie lands of Alabama and Mississippi, and which is a valuable addition to the hay-producing crops. It is doubtless descended from some of the numerous varieties which the Department brought from China about thirty years ago, and in general appearance it is much like the common broom corn, though the heads are less spreading and the stalk usually branches at several of the upper joints. It is common in cornfields, starting up late in the summer, after the crop has been laid by; its growth is rapid, and in September many fields appear as though planted with common sorghum. If cut before heading it makes fair hay, and on rich soil will produce a heavy second crop. If allowed to mature the yield of seed is about the same as that of the ordinary cultivated varieties, and is worth about as much for feeding stock.

As in most other parts of the South, Bermuda grass and lespedeza furnish an abundance of summer grazing in this region; but it has been more difficult to find satisfactory plants for winter pastures here than for any other soils which the Department has investigated. Melilotus is thoroughly at home on these soils, and in nearly all localities has been so satisfactory that little else seems to be needed. Alsike clover grows well on the heavier soils, but soon disappears from the ridges and looser soils. Hungarian brome grass, orchard grass, and redtop are the best of the true grasses for general use, while Texas blue grass has done well in a few localities. Bar clover and hairy vetch succeed admirably where the soil is fairly dry, but neither will grow where the ground is wet for considerable periods of time.

THE PINE WOODS REGION.

The pine woods region reaches from 50 to 150 miles back from the coast, and extends in an unbroken line from Carolina to Texas, except where interrupted by the mouths of the larger rivers. The soil is usually a sandy loam containing but little lime, and underlaid with a heavy clay subsoil. Where the woods are open native grasses flourish in great abundance, and thousands of cattle and sheep are raised which never see a pound of hay or grain, though the living which such animals get is a hard one, the beef being poor in quality and the wool light in yield. Here hay-growing is of less importance than farther north, but it has become generally recognized that, although animals may live through the winters on the native pastures, it is more profitable to shelter and feed them during the heavy winter rains, and that an occasional hay crop is a cheaper and better fertilizer than can be secured in any other way.

On ground which has been well fertilized Bermuda is the best grass for permanent meadows, but a majority of the planters in this region, where the growing season lasts nearly twelve months, find it more profitable to make hay upon lands from which some other crop has been harvested, and in many cases the hay is secured for the bare cost of gathering. Along the Gulf coast crab grass and Mexican clover form the bulk of the hay crop. Both of these plants "come in" on the cultivated lands, and both make a heavy spontaneous growth late in the season, maturing at the same time, and if cut before becoming too ripe making most excellent hay. Alfalfa does well where the soil is sufficiently fertile, and has proved remarkably successful on some of the drier lands of Florida. On the Atlantic coast crimson clover is one of the best of hay plants, and its introduction is making great changes in the hay-growing practice of that region. Dr. Battle, who has had charge of the Department work in North Carolina, says of it: "Hay made from the crimson (scarlet) clover stands out frequently as the richest of foods. It leads pea-vine hay, lucern, red clover, timothy, redtop, alsike clover, and orchard grass." Timothy and red clover

also do well in North Carolina, and in many localities Johnson grass is highly valued.

When the crop is wanted for its fertilizing effect as much as for its hay, the cowpea is the best plant that can be grown. If sown early two crops can be made during the season, and if not sown before August the vines will still have time to cover the ground with a dense growth which can be cut for hay, pastured, or left to decay on the ground, at the convenience of the planter. Lespedeza makes heavy crops on such of these soils as contain a small amount of lime; but melilotus has not been generally successful.

For winter pastures in the Atlantic coast region, crimson clover is valued highly, as it makes both winter pasturage and a winter growing fertilizer, being one of the few plants which can be used for this double purpose. Japanese rye and orchard grasses also succeed well there, and in some localities Texas blue grass has done well. In Florida the best winter pastures have been made from alfalfa and Texas blue grass; while along the Gulf coast carpet grass and the large water grass have been more valuable.

FORMATION AND CARE OF PASTURES.

Preparation of the land.—The ground should be well plowed only a few days before the seed is to be sown, and then harrowed until the surface is thoroughly pulverized and smoothed. If hard and full of clods, a disk harrow is the best thing we have found for pulverizing the soil, and it should be used as soon as possible after the plowing is done before the clods have time to bake. The last harrowing should be done with a Thomas or some similar harrow in order to leave the surface as smooth as possible.

Small and heavy seed, like clover, can be sown more evenly with a "wheelbarrow seeder," of which there are several kinds in the market, than with any other implement we have used; but for sowing coarser seeds, like Johnson grass, or chaffy seeds, like those of orchard grass, we have found no machine which has been satisfactory, and we prefer to sow such seeds by hand. Light and heavy seeds should always be sown separately, as it is practically impossible to keep them evenly mixed, and in sowing by hand the heavy seeds will be thrown so much farther than the light that the field will be streaked and irregular. When the sowing is done by hand we prefer to go over the field twice, using half of the seed each time and making the second sowing at right angles to the first.

For covering the seeds we prefer a heavy roller to any other implement, as it covers them more thoroughly and presses the soil about them so firmly that fewer are lost by rains and drought. If a roller is not to be had, a light smoothing harrow or even a brush may be used, but a heavy harrow should never be used except for covering very coarse seeds. When the ground is in good condition, freshly harrowed,

and loose, and the seed can be sowed just before a rain, covering is scarcely necessary, and we prefer to omit it altogether rather than to use a heavy harrow.

Time of sowing.—In the South nearly all perennial grasses and clovers will do better if sowed in August or September than at any other time, as they then become well established before the winter frosts, and are ready to make such a vigorous growth early in the spring that they will keep down the weeds and volunteer grasses which so often choke out the spring sowings. Some of the more hardy species will do well if sown as late as October or November, though even for these the earlier sowing is preferable. If the land has been occupied by other crops so that fall sowing is not practicable, the work should be done as early in the spring as possible that the young plants may become well rooted before the summer drought. It is seldom advisable to sow with grain.

Application of fertilizer.—No satisfactory crops of hay can be made to grow on soils too exhausted or too barren to produce fair crops of corn or cotton, and fertilizers are as necessary and as profitable for the hay field as elsewhere. The use of fertilizers is more important for meadows than for pastures, from the fact that droppings from the stock will in a great measure compensate for the material carried away: but when pastures have been used so long that the ground has become hard, and the more tender plants have been killed out by trampling and close grazing, it will pay well to plow, fertilize, and reseed the ground.

Stable manure and cotton seed are the best fertilizers for plowing under before the seed is planted, and a liberal application of these will be all that is needed for two or three years; but on permanent meadows top-dressing must finally be employed to keep them in good condition. It is seldom necessary to use phosphoric acid on soils containing even a moderate proportion of lime; but all the true grasses are heavy consumers of potash and nitrogen, both of which it will pay to supply in liberal quantities. For ordinary soils 50 pounds of potash per acre is a liberal annual application, and this may be secured by using 400 pounds of kainit, 250 of cotton-hull ashes, or 100 of muriate of potash. Estimating the potash at the usual rate of 5 cents per pound, the relative value of these fertilizers per ton is as follows: Kainit, \$12; cotton-hull ashes, \$20; and muriate of potash, \$50; but as the market prices are quite variable, the selection of the one for use will depend on their local cost. For soils which are deficient in lime, and where phosphoric acid is needed, the cotton-hull ashes have an additional value of about \$9 per ton on account of the phosphoric acid which they contain, and for such soils these ashes are usually the cheapest fertilizer.

When phosphoric acid alone is needed, it may be purchased most cheaply in the form of acid phosphate. The cheapest form in which nitrogen can be purchased is as nitrate of soda or as cotton-seed meal,

the former having about double the amount of nitrogen contained in the latter. The meal contains approximately 7 per cent of nitrogen, 3 of phosphoric acid, and 2 of potash, which makes it practically a complete fertilizer. It is one of the best materials we have for use as a top-dressing on grass lands.

It apparently makes little difference when phosphatic and potassic fertilizers are applied, but as the nitrogenous compounds are very quickly dissolved and lost, they should be applied only for immediate effect. If but one application is to be made it should be given when the grass is commencing its growth in the spring. The mixture which has given us the best satisfaction on grass lands containing lime has been equal weights of cotton-hull ashes and cotton-seed meal. For lands deficient in lime we use the same mixture, and add a separate application of acid phosphate early in the spring. Cotton-seed meal produces little effect on the clovers, and for such crops we have found a mixture of equal weights of ashes and land plaster most effective, adding the separate application of acid phosphate when the soil is deficient in lime.

We have found no machine which will distribute these fertilizers more evenly and economically than can be done by hand.

DESCRIPTION OF THE FORAGE PLANTS SUCCESSFULLY CULTIVATED IN THE SOUTH.

In tests of forage plants at the experiment stations the usual plan has been to make the first sowings of each species on small plats where they would receive all necessary care and attention, but even under these favorable conditions many species, especially of those received from India and Australia, failed to give satisfactory results and were discarded. Such species as succeeded well on the small plats were afterwards sowed in open fields, where they received only ordinary care, in order that their practical value might be fully shown.

The special characteristics and value of the most successful species are briefly stated below:

THE TRUE GRASSES.

Of the 364 species of the true grasses, as distinguished from the clovers and other forage plants which have been tested during the past five years, the following have succeeded best and seem to have the greatest value for cultivation in the South:

Japanese rye grass (*Agropyrum japonicum*).—In nearly every location where it has been planted this grass has done well. It is a perennial which resembles rescue grass, and like that species makes its best growth during the cool months. It is therefore valuable for winter grazing, but its yield is too small for hay. It does well on dry ground and makes a fair growth from November to March, after which it seeds

freely and grows but little during the summer. It has done well at the Louisiana Station, where it begins its growth early in the fall and lasts until late in the summer; at the North Carolina Station it promises to hold its own with orchard grass; at the Georgia Station it has been less permanent, while in Mississippi it stands well on rich soil, but soon disappears from the poorer lands. Seed should be sown in August or September, at the rate of 40 pounds per acre. (Fig. 1.)



FIG. 1.—Japanese rye grass.

Redtop (Agrostis alba).—This has succeeded well in permanent pastures on all soils containing a fair supply of moisture, especially in Louisiana, on the river bottom lands, and on the “seepy” hills of the yellow-loam region. It will yield one cutting of hay, and by repeated mowings it may be made to hold its ground during the summer, but its chief value is as a part of the mixture of grasses for winter pasture. Its growth during the first season is rather weak and disappointing, but it strengthens and improves with age, holding its own well against other grasses and weeds, and is not

easily killed by overflows, even when covered with water two or three weeks at a time. It does better on a clay soil than on one which is too sandy, and in favorable locations furnishes good winter grazing. There are several varieties of this grass which are much alike in general appearance, but the one known as “Rhode Island bent” or “creeping bent” forms the best sod, and is the one to be preferred for pastures. Seed should be sown early in the spring, at the rate of 25 pounds per acre if sown alone; but its growth is so weak during the first season that we have found it better to use from 15 to 20 pounds, and to mix it with from 30 to 40 pounds of perennial rye grass, as the latter makes a quick and vigorous growth which disappears at the end of the first season, when the redtop will cover the ground.

Hungarian brome grass (Bromus inermis) (also called smooth brome).—This grass is a native of southern Russia, and endures our summer heat and drought much better than does its near relative, resene grass, and, being a perennial, is much more permanent. It remains fresh and green during a larger part of the year than any other grass we have grown, with the exception of the large water grass, and, as it is at its best during the late fall and early spring months, it is especially valuable for winter pastures. In favorable locations it main-



FIG. 2.—Hungarian brome grass.

tains itself well against other grasses and weeds, bears grazing well, and is not injured by moderate frosts. It produces a great amount of long tender leaves very near the ground, while the culms are slender and not numerous, so that it is better for grazing than for making hay. It covers the ground more evenly than rescue grass, and for grazing purposes is decidedly superior to that species. Like nearly all grasses it makes its best growth on rich soils, but even on rather thin and barren fields it is one of the best. Seed is produced very sparingly, and is hard to obtain in this country. It should be sown in February or March at the rate of from 30 to 40 pounds per acre. (Fig. 2.)

Rescue grass (*Bromus unioloides*).—This is a native of the western part of the United States, and was one of the first of our native species to be brought into cultivation, having been grown for many years under the names "Australian oats," "Schrader's brome grass," etc., and more recently under the name "Arctic grass." It is usually an annual, though if grazed closely or mowed frequently the roots will often live several years in rich and not too heavy soil. It makes the best growth during the cooler months, usually starting up in October or November, and continuing to grow until it ripens its seeds in April or May, after which little is seen of it until cool weather comes again, as it does not bear heat and drought. Its growth largely depends on the character of the season, and in favorable years it gives excellent pasture from November to May, while in other seasons it may make but little growth before February. On thin and dry soils its growth is small, from 12 to 15 inches, but on rich and somewhat damp soils it makes a growth of 3 feet or more, with a large proportion of leaves, which are tender, sweet, and nutritious, and which are renewed very quickly after being eaten down. If used for making hay, in a favorable season it will give a good cutting in February and another in April, and the third crop will make sufficient seed to stock the field for the next year. As its growth varies so much with different seasons it can hardly be relied upon for winter pastures, though it never fails to make an abundant growth early in the spring, and its chief value is for mixing with other plants like orchard grass, bur clover, and vetches. Along the Gulf coast its growth is less dependent on the seasons, and in Louisiana it is regarded as being one of the best winter grasses. Seed should be sown in August or early in September, at the rate of from 30 to 40 pounds per acre. (Fig. 3.)



FIG. 3.—Rescue grass.

Orchard grass (*Dactylis glomerata*).—This has given a better winter growth on wet and heavy clay soils with ordinary field treatment than any other grass which we have tested. It is a perennial which

commences its spring growth with the first warm days of February, and if not pastured, is ready to cut for hay in April, and will then afford excellent grazing until checked by the summer drought. With the first autumn rains it starts a new growth of leaves, making rich fall pasturage, and remaining fresh and green all through the winter. The hay made from it is of excellent quality, though its habit of growing in large clumps is against its use as a hay grass; but it bears grazing well and recovers quickly when cropped down. It does well when mixed with redtop, and succeeds better than almost any other grass in woodland pastures. Sandy soils are not suited to its growth, and it can not be recommended for any light and thin lands. Seed should be sown in August or very early in the spring at the



FIG. 4.—Orchard grass. rate of from 30 to 40 pounds per acre. (Fig. 4.)

Terrell grass (*Elymus virginicus*).—This is a native perennial grass which has received little attention, but which is of considerable value for winter pastures. It grows most abundantly along creek banks, in fence rows, and on the borders of woodlands, but with proper care can be made to grow on almost any soil. This grass makes its best growth during the fall and winter months, and it is ready to cut in May, but the hay made from it is of inferior quality; its special value is for winter pastures. It commences its fall growth on the approach of cool weather, just before lespedeza is killed by frosts, and continues green and luxuriant until it begins to seed in April or May. Although a perennial, it is short lived under close grazing, and stock should be taken from the fields sufficiently early to allow it to ripen its crop of seed, which is produced in great abundance. The land on which it grows will give a crop of lespedeza during the summer, which may be pastured from June onward, and by the time the lespedeza is gone the grass will be ready for the fall and winter grazing. Experience with Terrell grass at the experiment stations indicates that, like rescue grass, it will be of considerable value under good management, though of little use when it fails to receive the proper attention. Seed should be sown in August at the rate of from 30 to 40 pounds per acre. (Fig. 5.)



FIG. 5.—Terrell grass.

Teosinte (*Euchlœna luxurians*).—This plant needs a long season of hot weather, a rich soil, and abundant moisture in order to succeed well, and it is useless to plant it where all these conditions can not be had. It is a remarkably vigorous grower, reaching 10 or 12 feet in height, with an unusually abundant supply of leaves and slender

stems which continue to grow until killed by frosts. If cut when it reaches 4 or 5 feet in height it makes excellent fodder, and will produce a second crop fully as large as the first. If left to grow until September or October it furnishes excellent material for the silo, in greater amount per acre than either corn or sorghum, and we have found no other plant which is its equal for soiling purposes. Its leaves are similar to those of sorghum, but much longer; the stalks contain from 8 to 10 per cent of sugar. The plants stool freely, sometimes as many as 50 stalks growing from a single seed. It has done fairly well at the Georgia and Mississippi Experiment Stations and very little in North Carolina, but has made a heavier crop than any other plant which has been grown at the Florida and Louisiana Stations. In Mississippi the heaviest yield has been 22 tons per acre, while the Louisiana Station reports the enormous yield of over 50 tons of green forage per acre. Its value for feeding is apparent from the fact that the entire crop grown at the Louisiana Station was sold to local dairy-men at the rate of \$2 per ton while standing in the field. Its season of growth is so long that it seldom matures north of latitude 30 degrees, but it has ripened well at the Florida and Louisiana Stations. The seed, 4 to 5 pounds per acre, should be planted in hills 4 or 5 feet apart each way, about the time when cotton is planted, and the crop cultivated like corn. The greater distance should be given on the richer soils. (Fig. 6.)



FIG. 6.—Teosinte.

Bermuda grass (Cynodon dactylon).—Bermuda grass is to the South what Kentucky blue grass is to the North, and is the best hay grass for all rich soils. It will grow well on any rich soil, whether wet or dry, but never makes a satisfactory growth on barren soils of any kind. In favorable seasons it will give two cuttings, and on good soils its yield is from 2 to 4 tons of hay per acre. Having very slender stems with an abundance of leaves it is easily masticated and is relished by all kinds of stock, being especially valuable for horses and mules, though of less value for calves and milch cows. When once established in a field it is somewhat difficult to eradicate, and this is sometimes an objection to its general cultivation. The best method of



FIG. 7.—Bermuda grass.

destroying it is to plow the ground immediately after the hay is cut, leaving it as rough as possible. Plow again in November and sow to oats, and when that crop is harvested plow again and sow thickly with cowpeas, which will smother the few plants of the grass which may have survived the oats and will leave the land in the best possible condition for any future crop. As Bermuda grass rarely produces seed it is usually propagated by transplanting the roots. This may be done preferably when the ground is thoroughly wet and soft, at almost any time except in the winter months, and is not more expensive than is the seeding of the ground in the ordinary manner. Shave off sods an inch or two in thickness, cut them into pieces about an inch square and drop on the new ground about 2 feet apart each way, stepping on each one and crowding it well into the soft ground as it is dropped. If it is necessary to do the work when the ground is too hard for this method, one man can make small holes with a single stroke of a hoc, while another drops the sods and covers them with his foot. When the ground is in good condition and the sods convenient, one man can plant an acre in a day. Good stands can be secured in time by scattering a dozen or more sods to the acre and then cultivating the land in corn or cotton for two or three years, after which the grass will have become so well distributed that the field will need only to be plowed and harrowed smooth to make a good meadow. If the meadow is plowed and harrowed in the spring, once in from three to five years, the yield is greatly increased, and the grass responds very quickly to an application of fertilizer, especially stable manure. (Fig. 7.)

Perennial rye grass (*Lolium perenne*) (also known as Randall grass and English meadow grass).—For sowing with redtop and other slow-growing sorts when immediate results are wanted for either pasture or hay, this is one of the best varieties, but it will seldom make a permanent meadow or pasture, as it can not endure heat. It makes a quick and rapid growth, covering the ground well in a few weeks after sowing, and if sown in the fall it will give a good cutting for hay in April, after which little will be seen of it except in unusually favorable locations. It is important that the crop should be cut as soon as well grown, since if this is not done the warm rains of June and July cause the leaves to decay very rapidly and so smother the small plants of other grasses which may be growing on the same ground. On deep, rich river bottom lands, especially in Louisiana, it often holds its own for some years and will give two or three cuttings during each season, but this is not common, and it never lasts more than one season when closely pastured. Sow seed in October or February, at the rate of from 50 to 60 pounds per acre if sown alone, or half that amount if with redtop and other grasses. (Fig. 8.)



FIG. 8.—Perennial rye grass.

Guinea grass (*Panicum jumentorum*).—This is a native of Africa, and the Department first called attention to its value in 1873, when a considerable quantity of the seed was imported and distributed in the Southern States. It is a perennial which requires a long season for its growth, and since it ripens seed only in the extreme South it is more commonly propagated by dividing the roots. It has proved to be well adapted for cultivation on the sandy soils of Florida, especially on worn-out pine lands where few other grasses have given satisfactory results: When allowed to mature it grows from 8 to 10 feet high, but in order to secure satisfactory hay or forage for soiling, it should be cut when not more than 3 feet high, and it will furnish such a cutting every month or six weeks from April to November. Few plants will yield a greater amount of fodder, and for a region of only slight frosts and frequent rains it is one of the best forage crops we have. Plants should be set about 3 feet apart each way in March, or seed may be sown at the same time. (Fig. 9.)



FIG. 9.—Guinea grass.

Crab grass (*Panicum sanguinale*).—In the Northern States this is regarded as a troublesome weed and wholly worthless, but in the South its character is very different. It makes a heavy spontaneous growth on fields from which wheat, oats, corn, or other early crops have been harvested, and on good soils will yield 2 tons per acre of hay, which, if cut before it is too ripe, is fully equal in value to timothy. In order to secure hay of the best quality it is essential that it be cut as soon as it is fully grown. On land which was plowed in February, and on which no other crop was grown, we have cut four crops of about 1 ton each per acre in a single season. As it makes its best growth late in the fall, and as the hay made from it costs nothing but the harvesting, it is valued highly. It makes its best growth on the sandy pine lands along the Gulf coast, where it furnishes three fourths of the hay, and where many of the planters say they wish for no better hay grass, as this is good in quality, inexpensive, and a sure crop. Mexican clover is usually found on the same lands, and as it is also a volunteer crop, growing at the same time with crab grass, it adds largely to the yield, and is claimed by many planters to improve the quality of the hay. (Fig. 10.)



FIG. 10.—Crab grass.

Texas millet (*Panicum texanum*).—In the river bottom lands, especially in the extreme Southwest, this is valued highly for a late hay crop. It is an annual, growing from 2 to 4 feet high, very leafy, and better for hay than for grazing. It prefers rich alluvial soils, where it "comes

in" as does the crab grass; on dry uplands its yield is not large. Like crab grass, it should be cut early, before the seeds have matured, when it makes excellent hay, but if left until fully ripe the stems become too hard and woody, and a large part of the seeds drop and are lost. It has not succeeded well in the Atlantic States nor in the northern parts of the Gulf States, but seems specially adapted for use on the river bottom lands of the Southwest. Seed may be sown at any time during the early summer at the rate of 40 pounds per acre, and when one crop has been grown the land will not need reseeding. (Fig. 11.)



FIG. 11.—Texas millet.

Large water grass (Paspalum dilatatum).—This is a native species which has received far less attention than it deserves, though it is found in all parts of the South, growing most abundantly on low, black soils where there is an abundance of moisture. It is a perennial, and spreads slowly from the roots, but it seeds freely, and when once started will soon

cover a field where the soil is suited to its growth. It grows from 2 to 5 feet high, and the stems are rather coarse for hay unless cut early; but it produces an immense amount of long broad leaves, which remain fresh and green during the entire winter excepting after unusually heavy frosts. It endures the longest droughts without injury, bears grazing well, starts into growth early in the spring, and is one of our best pasture grasses. Its habit of growing in clumps is against its use for hay, but it is an excellent variety for mixing with redtop for permanent pastures, as it grows best on the same character of soil and largely increases the yield. Seed is rarely found in the market, but a supply can be gathered with little trouble; it may be sown as soon as gathered or early in the spring.

Carpet grass (Paspalum platycaule).—On the sandy soils of the South Atlantic and Gulf States this is the most desirable of all grasses for pastures, though its growth is too flat and spreading to make it of value for hay. It is a perennial and, as its name indicates, has a creeping habit of growth which covers the ground rapidly and thoroughly. It is not injured by either frost or drought, and will bear more hard trampling and close grazing than any other grass which has been planted in these tests. It is seldom found on the unsettled lands which have not been trampled, but whenever

a field is pastured closely it soon "comes in" and gives good grazing during the entire year. It prefers a sandy soil to one which is heavy, and will grow well even where the sand is quite loose, provided it be



FIG. 12.—Carpet grass.

well trampled, as the trampling seeming to be essential to its successful growth on any soil. It starts well from the seed, and when once established grows rapidly, a single plant often covering from 10 to 20 square feet in the season. It roots at every joint like Bermuda grass, but unlike that plant it is not injured by frosts and is readily destroyed by cultivation. It can be introduced into new fields as directed for Bermuda grass, or if it is mowed late in the season, after the seed has matured and the hay is scattered over the new field, it will soon make good pasturage. (Fig. 12.)

Timothy (Phleum pratense).—Although this has been planted repeatedly, not only on the grounds of the stations, but in other places as well, it has rarely given satisfactory returns, and usually disappears during the second or third year from seeding. It has done better at the North Carolina Experiment Station than elsewhere.

Kentucky blue grass (Poa pratensis).—This has not given the uniform success here which it has farther north, though in many places, especially in North Carolina, northern Georgia, and on the lime soils of northern Mississippi, it is of considerable value. On low ground, where the soil is dark-colored and contains an abundance of lime, and on “seepy” hillsides, we have seen a few pastures of this grass which afforded good grazing in the late fall and winter months, but it is useless to sow it on the dry clay hills or in the sandy pine woods region. Here it remains almost dormant during the hot weather and its chief value is for mixing with Bermuda grass, lespedeza, and other summer-growing species. Seed should be sown in September, at the rate of 40 pounds per acre. It shows but little during the first year from seeding, but if the soil is suitable it continues to improve for many years. (Fig. 13.)



Fig. 13.—Kentucky blue grass.

German millet (Setaria italica).—When a crop of hay is wanted from land which has been occupied by oats or any other early crop, German millet can often be used to advantage. It is a grass which requires rich land and which is very exhausting to the soil; it should not be put on land which is to be used next for cotton or grain, though it may often be used to precede clover or the seeding of the field for a permanent pasture. If cut early before the seeds begin to harden it makes excellent hay, but if the seeds are allowed to mature the stems become so hard and woody that they are not eaten well, and the seeds, if fed in any considerable quantity, are often injurious to horses and mules, though not so to cattle. The crop sometimes fails on account of a drought soon after sowing, but if rains follow so as to germinate the seed and give the plants a fair start, they suffer but little from later droughts. There are several varieties, differing principally in size, the form known as “German millet” being the largest, growing from 3 to

5 feet high and making the best yield on heavy soils; the "common millet," growing from 2½ to 4 feet high, and being the best variety for light soils; and the "Hungarian millet," which is the smallest and most quickly maturing sort of the three. Seed may be sown at almost any time during the summer, even as late as the first of August, at the rate of from 25 to 30 pounds per acre.



Fig. 14.—Johnson grass.

Johnson grass (Sorghum halepense).—This is at the same time one of the most valuable grasses and one of the most troublesome weeds to be found in the South. It is a perennial, which is easily propagated by either seeds or roots, and which makes its best growth on rich bottom lands, where it soon occupies the whole ground, giving three cuttings of about 2 tons each when in good condition. The planter who wishes to grow hay and nothing else, and who has no regard for the rights of his neighbors, will find this a valuable species. We have

never seen it permanently cleared from a field where it had once become thoroughly established. (Fig. 14.)

LEGUMINOUS PLANTS.

While the true grasses will always furnish the bulk of the hay crop and the greater part of the pastures, the cultivation of the clevers, melilotus, cowpeas, and other leguminous plants is an essential part of all successful farming, on account of the marked effect which they have in fertilizing and preparing the soil for future crops. The parts of the plants which are above the soil are valuable as food for stock, and those parts which are below the surface of the ground are often of equal value as food for future crops. This is especially true in the Southern States, where the subsoil is often very compact and impervious to water, and where the long-continued heat hastens nitrification and causes the rapid destruction and waste of vegetable matter in the soil. As all of the legumes are deep-rooting plants, they aid greatly in loosening the subsoil, and in consequence cause it to suffer less from excessive rains or from drought; they furnish a large amount of humus, and with a proper rotation of crops will furnish all the nitrogen, the most expensive element in fertilizers, that will be needed for other crops. Soils may be rested and greatly improved by the growing of true grasses, but the same effects can be secured more rapidly, economically, and profitably with leguminous crops, which at the same time will furnish better grazing and hay for all fattening and milch animals.

There are but few of the legumes which will make permanent pastures or meadows, and for such fields the true grasses must be the main dependence, but in most cases the planter will find it more profitable to follow a rotation which will keep his land in forage crops only so long as may be necessary to prepare it for other crops, and for this

two years is usually sufficient. While leguminous crops are restorative in the highest degree for a few years, their long continued cultivation on the same ground finally renders the soil incapable of reproducing them profitably. A rotation of crops is universally recognized as being an essential to the highest success in farming, and this rule applies to forage crops as well as to those cultivated with the plow and hoe. In the Southern States the planter has his choice among a large number of these restorative crops, which vary from three months to as many years in completing their growth, and some one of which will be found suited to almost every circumstance in which such a crop may be wanted.

In experiments conducted under the writer's supervision the following species were found to be the most valuable of the leguminous plants:

Cowpea (Dolichos sinensis).—There is no other crop which is planted so extensively in the South, both for its hay and its fertilizing value, and we have found no other plant which will produce as large an amount of forage and valuable fertilizing material in as short a time. It may be sown at almost any time during the summer, will grow on any soil except the most barren, and makes excellent hay and pasture. Its long deep roots bring a large amount of plant food from the subsoil and leave it near the surface, where it is available for future crops. There are many varieties of the plant, which are quite different in their habit of growth. Some, like the Unknown and the Clay, produce an immense growth of vine, and require a long season, while others, like the "Pea of the Backwoods," are quite dwarf and mature in two months from planting. Seed of most varieties must be sown every year, though of some, like the Red Tory, the seed may be plowed under in the fall, and the land sown in oats, when another crop will be produced after the oats are harvested. When sown broadcast after wheat, oats, or other early crop, the running sorts make a heavy yield of hay, which, although somewhat difficult to cure, is of the very best quality. Hay of this kind is used almost exclusively to furnish forage for mules on the sugar plantations of Louisiana. By growing such a crop hay is made at a very small expense, and the soil is shaded during the driest and hottest months, and left loose and mellow and in the best possible condition for any future crop.

It is often desirable to plow under some green crop when it is impossible to give up the land for the two years necessary to grow a crop of red clover or melilotus, and in such cases we have no other plant which can take the place of cowpeas. Many planters use the dwarf varieties for planting between the rows of corn or cotton at the last plowing, as when grown in this way they do not interfere with the growing crop and will give a fair yield of seed. The decaying vines make a most excellent covering for the soil during the winter, or they may be used for late pasture. The roots penetrate the soil as deeply as those of red clover, a fact which makes the crop especially valuable for heavy

soils requiring drainage. There is no other crop which will furnish the same amount of material for plowing under at so small a cost. When land is not in use for other crops for even two months during the summer it will always pay well to seed it with peas, as the seed or forage which can be gathered will fully pay the cost of seeding and leave the fertilizing value of the crop as clear profit. Seed may be sown at any time from May to August, the amount per acre depending upon the variety and time of sowing. If one of the large varieties is planted in hills early in the season two quarts will plant an acre, but if dwarf varieties are sown broadcast in August not less than a bushel should be used.

Lespedeza, or Japan clover (Lespedeza striata).—This plant, which came to this country from Japan, was first noticed in South Carolina, but has now become naturalized as far west as Texas and north to the Ohio River. It is an annual which perpetuates itself without care, and will make a fair growth on the poorest and driest clay hills. It starts rather late in the spring, making little show before June; but from that time on it grows rapidly, and is eaten greedily by all kinds of stock until killed by frost. On sterile soils its growth is flat and spreading, and it is fit only for pasture; but where the soil is of good quality it will grow from 20 to 30 inches high and yield 2 tons per acre of hay which is fully equal in value to the best clover, and is the most profitable hay which can be grown on thin soils for feeding to milch cows and fattening animals. This is not only one of the best hay and pasture plants, but it is also one of the best for fertilizing purposes, as it sends its roots deep into the ground, and will grow on soils too barren for the growth of other legumes. Like most other plants belonging to the same family, it does best on a lime soil, but it will do well on the red clay hills where red clover and melilotus fail. It has not succeeded well on the sandy soils of the pine woods region. Seed should be sown at the rate of a half bushel per acre, with oats in the fall, or by itself early in the spring.

Alfalfa (Medicago sativa).—This plant makes such heavy yields in favorable locations that it has received special attention at the experiment stations, but has given widely varying results. On moderately rich and sandy soils it has proved quite valuable for soiling purposes, furnishing cuttings as early as February, with frequent successive until late in the summer, while on dry hills or heavy clay, and on soils where there is a lack of drainage its growth has been weak and unsatisfactory. It has made a better growth on the alluvial soil of the Louisiana Station than any other hay and pasture plant which has been tested, and is the only plant yet found which will successfully occupy the ground throughout the entire year. At that station the first sowing was made in October, 1890; and in June, 1892, twenty months after planting, fourteen cuttings, averaging nearly $1\frac{1}{2}$ tons per acre, had been taken from the land. Another field sowed in March, 1892, had given

two cuttings by the end of June. At the Mississippi Station a field was sown in 1889 which gave three cuttings of about $1\frac{1}{2}$ tons each in 1890, while in 1892 the yield had decreased to three cuttings of about 1 ton each. In Florida it has succeeded well when a stand has been secured, while in Georgia and North Carolina it has been less promising. It is difficult to secure a full stand, as the young plants are easily killed by either excessive rains or a hot sun, and we have found September and October the most favorable months for sowing the seed. Sow at the rate of from 20 to 25 pounds per acre.

Bur clover (*Medicago maculata*).—This is an annual plant which makes good winter grazing on rich soils, but which is worthless for summer use and of little value for hay. It is essentially a winter grower, being at its best from February to May, after which it ripens its seed and soon disappears. Horses do not eat it well when other clovers or grasses are abundant, but cattle seem quite fond of it and hogs eat it greedily. We have found it an excellent plant for sowing on Bermuda grass land, as it matures its seed and dies at about the time the Bermuda grass starts into growth, and when the latter is killed by frosts this soon takes its place. A mixture of these two plants comes nearer giving continuous grazing than any other mixture we have tested. For its best growth this clover should have a light and rich soil, and in such a soil will recede the ground freely, even though the field be plowed for a summer crop. Sow in August at the rate of 15 pounds per acre.

Melilotus (*Melilotus alba*).—This plant bears a close resemblance to alfalfa, but is larger and coarser in every way and is especially adapted for use on calcareous soils. It will make an excellent growth on any lime lands, even on the "rotten limestone" hills and on soils so barren that they will sustain no other plants, but it is of almost no value on the red clays and the sandy pine woods soils, which contain little lime. It is a biennial plant, making only a moderate growth the first season, but during the second season it will grow from 4 to 7 feet in height if not cut, and make stronger and heavier roots than any other forage crop. At the end of the second season it matures its seed and dies, and the roots then decay quickly. It is not generally liked by animals unaccustomed to it, but as it starts into growth very early in the spring when other green forage is scarce, stock turned on it at that time soon acquire a taste for it and eat it readily throughout the remainder of the season. When grown for hay one and sometimes two crops can be cut in the fall after sowing in the spring, and during the next season two or three crops may be cut. Unless cut early the stems become hard and woody, and in all cases care is necessary in handling in order to prevent the loss of



FIG. 15.—*Melilotus alba*.

leaves which readily drop from the stems. Excellent hay may be made by sowing it on lands which have been set in Johnson grass, the mixture seeming to improve the palatability of both. From land cultivated in this manner we have seen three cuttings of about 2 tons each made in a season. As a restorative crop for yellow loam and white lime lands this plant has no superior, and for black prairie soils it has no equal. The roots are very long, penetrating the soil to a depth of 3 or 4 feet, are quite large, and by their decay at the end of the second year leave the soil with innumerable minute holes, which act as drains to carry off the surplus water and loosen the soil so that the roots of other crops can go deeper, find more abundant supplies of food, and bear drought better. While the hay from this plant will not sell as well as that from lespedeza, the crop is heavier, furnishes pasture earlier in the spring, and is by far the most valuable crop we have for a natural fertilizer. Seed should be sown in August or February at the rate of half a bushel per acre. (Fig. 15.)

Alsike clover (*Trifolium hybridum*).—This, too, varies greatly with the soil on which it is grown, succeeding best on rather low and rich soils, and doing well on soils which are too wet and heavy for the growth of any other clovers. It is a perennial, similar to the white clover in its persistency and general habit, but having nearly the size and vigor of the red clover, which makes it one of the best of pasture plants on suitable soils. Its yield of hay is light, but it bears grazing well, grows thriftily, and bears heavy frosts without injury. It has grown well on heavy and "seepy" clay soils, but has been of little value in dry upland fields as drought injures it seriously and it soon disappears from fields where it does not have an abundant supply of moisture. It is the best of the clovers for mixing with redtop, as it requires the same character of soil and remains in good condition long after the grass has ceased growing. Sow in August or February at the rate of 10 pounds per acre.

Crimson clover (*Trifolium incarnatum*) (also known as scarlet clover).—This clover has attracted great attention in the South during the last three or four years, but the position which it will finally hold is still uncertain. It has succeeded better and seemed to be more at home on the Atlantic coast than elsewhere, and has given better results at the North Carolina Experiment Station than in either Georgia or Mississippi. It has also done well in Louisiana, and in speaking of its growth there Prof. Stubbs says: "It is thoroughly at home in every part of the State, making a large crop of excellent hay. A combination of this crop and cowpeas affords the readiest means of quickly restoring worn-out lands or of furnishing a continual supply of fresh hay for stock." It is an annual which commences its growth with the autumn rains, often affording good pasturage from November to April, when it matures its seed and dies. On favorable soils it reseeds the ground freely and so will produce successive crops from a single seeding, even

though the ground be plowed and used for short summer crops like oats or millet. Hay made from it is of good quality, and a yield of 2 tons per acre is not uncommon, though as it matures during cool weather the hay is somewhat difficult to cure. It makes excellent grazing during the fall months after most other feed becomes dry and scarce. Its principal value, however, is as a green crop to be plowed under, as it can be sown in the fall for plowing under in the spring, while the cowpea, melilotus, and most other green manuring crops are summer growers and should be plowed under in the fall. It varies greatly with the soil where it is grown, appearing to be most successful on rather heavy clays containing but little lime, and it has made only a weak and unsatisfactory growth when planted on the light sandy soils of the Gulf coast, although it made one heavy crop, followed by two failures, at the Florida Station. At the North Carolina Station it is valued highly, and good crops have been secured by sowing the seed broadcast in September and October without any previous preparation of the ground, though on other places only a few miles distant, where the ground dries and crusts very quickly, thorough preparation of the land and earlier sowing have been found necessary. Sow from 10 to 15 pounds of seed per acre. (Fig. 16.)



FIG. 16.—Crimson clover.

Red clover (*Trifolium pratense*).—Until recently it has been thought that red clover could not be grown in the Southern States, but our experience has been that on suitable soils and with proper management it will grow fully as well here as in any of the Northern States, and that, while it does not last as long here, its yield is heavier, and on account of its more rapid growth, the quality of hay is better. In North Carolina it has succeeded well and has maintained a full stand longer than in most other sections; while on the sandy white soil of the Florida Station it has done but little. At the Louisiana Station it has made a vigorous growth, affording two large cuttings during the first season, but it soon succumbs to the encroachments of native grasses. At the Mississippi Station on rich creek bottom and on black prairie soils it has given excellent results, making 2 tons of hay per acre in May, another ton in June, and in favorable seasons another ton in September, though the last cutting has been unreliable on account of summer droughts. Where such yields can be made it is one of the best crops which can be grown, but there are many localities in the South where it has not been found profitable. It requires a soil which is rich and in fairly good condition to secure a "catch" of the seed, and on many soils where it makes a promising start and yields two or three cuttings it soon becomes overrun with the native grasses and is choked out. Ordinarily it will

not pay to grow it more than two years on the same ground, as by the end of that time it will have done its best work in fertilizing the soil, and the land will give better returns if the last crop of clover is plowed under and the field planted to some other crop. As the plants produce seed abundantly here and are not infested with the insects which have recently caused so much damage to the crop in the Northern States, there seems to be no reason why the seed crop should not become of considerable importance.

Red clover is a universally recognized standard in estimating the values of all other crops, when grown either for hay or as a green manure, and we have made special efforts to test it on as great a variety of soils as possible, and do not hesitate to recommend it for all rich soils which are in good mechanical condition; but it is useless to sow it on barren fields, or on rough and poorly prepared lands of any kind. It seems best suited for growth on alluvial and black prairie soils, and has never been satisfactory on sandy or white lime lands. August sowings have given the best satisfaction, as the plants from such sowings are sufficiently strong to keep down any growth of wild grasses and weeds the next spring, and will give a heavy cutting of hay in May. If sown in February, the more common time, the first cutting will be principally of volunteer grasses, but the clover will give two good cuttings later. Sowing with oats in February is often successful, but the clover is often injured by cutting the oats, thus removing the shade just at the beginning of the hot weather. Sow 1 bushel of the seed to each 5 acres.

Hairy vetch (*Vicia villosa*).—Of the 28 vetches which the Department has tested this is by far the best. Seed of this species was first sown in October, 1888, and since that time it has given heavy annual crops on the same ground, although it has received no attention and the ground has not been plowed since the first sowing. In 1889 another field was sown and has given equally good results. It is an annual plant, similar in growth to a very slender and straggling pea vine, the vines often reaching 10 or 12 feet in length and covering the ground with a dense mat of forage 2 feet in depth. Its seeds germinate with the first autumn rains and in a favorable season cover the ground by the first of January and then furnish good grazing until April or May. If stock are taken off the field in March the plants will mature and reseed the ground freely for the next year, but if pastured until June the stand will be destroyed. Stock of all kinds eat



FIG. 17.—Hairy vetch.

it greedily, both in the pastures and when cut for hay. It bears our heaviest frosts without injury and it is one of the few plants which can be grown during the winter for green manuring. (Fig. 17.)

There is another vetch (*Vicia sativa*), the one commonly known simply as "vetch," which is quite largely grown in some sections of the South, but it is smaller in its growth, less hardy, and in every way inferior to the hairy vetch. The two are easily distinguished, as the hairy vetch has a dark-green hairy leaf and large clusters of purple flowers, while the common vetch has a light-green smooth leaf and small clusters of pink flowers.

We regard the hairy vetch as being the most valuable winter forage plant which the Department has imported, and unhesitatingly recommend it for cultivation on all rich soils. Sow in August or September, at the rate of 2 bushels per acre.

MEXICAN CLOVER (*Richardsonia scabra*).

This is not a true clover, but takes its name from its habit of growth, which is similar to that of red clover. It is an annual, a native of Mexico and Central America, and has become thoroughly naturalized in all the southern part of the pine-woods region. A sandy soil seems essential to its growth and, like the crab grass, it is much more abundant in cultivated fields than elsewhere, coming up after other crops are harvested and making its best growth late in the season. It is of little value for pasture, but when cut for hay the yield is often 2 tons or more per acre. The hay, which is usually mixed with more or less crab grass, is of excellent quality. While its roots do not go as deep as those of the true clovers, it makes such a rank growth that it is of considerable value as a fertilizer and for covering the ground through the winter.

SUMMARY.

With reference to the selection of forage plants adapted to different regions, the soils of the South Atlantic and Gulf States may be classified as follows:

(1) Yellow loam soils, (2) alluvial and river bottom soils, (3) black prairie soils, (4) pine woods soils.

The forage plants most successfully grown for different purposes on these soils are enumerated below:

Forage plants for yellow loam soils.—For permanent meadows on rich land, Bermuda grass; for a hay crop to occupy rich land two years, red clover; for a single hay crop on fair soils, cowpeas; on poor soil, lespedeza. For permanent pastures Bermuda grass and lespedeza, to which may be added on dry soils orchard grass, Hungarian brome grass, and bur clover; on wet soils the addition should consist of redtop, water grass, and alsike clover. Crimson clover, rescue grass, Terrell grass, and hairy vetch are recommended for winter pasture.

Forage plants for the alluvial and river bottom soils.—For permanent meadows, Bermuda grass and red clover; on wet spots, redtop; and on well-drained soils, alfalfa. For a hay crop for a single season, lespedeza or German millet. For pastures, Bermuda grass, lespedeza,

redtop, alsike clover, bur clover, alfalfa, Japanese rye grass, large water grass, and Terrell grass.

Forage plants for the black prairie soils.—For hay, Bermuda grass, red clover, and melilotus. For a hay crop for a single season, lespedeza. For a catch crop, following oats, potatoes, etc., cowpeas or German millet. For pastures, Bermuda grass, lespedeza, melilotus, alsike clover, Hungarian brome grass, orchard grass, redtop, bur clover, and hairy vetch.

Forage plants for the pine woods soils.—For hay, Bermuda grass, crab grass, Mexican clover, alfalfa, crimson clover, and lespedeza. For pastures, crimson clover, Japanese rye grass, orchard grass, carpet grass, and large water grass.

It must be remembered that variations in local conditions of soil and climate make it necessary to exercise great care in the selection of forage plants for particular purposes. The more complete statements of the conditions under which different species have proved successful, given in the body of this bulletin, should be considered in detail before definite conclusions are drawn regarding the value of particular plants for any locality.

FARMERS' BULLETINS.

These bulletins are sent free of charge to any address upon application to the Secretary of Agriculture, Washington, D. C. Only the following are available for distribution:

- No. 15. Some Destructive Potato Diseases: What They Are and How to Prevent Them. Pp. 8.
- No. 16. Leguminous Plants for Green Manuring and for Feeding. Pp. 24.
- No. 18. Forage Plants for the South. Pp. 30.
- No. 19. Important Insecticides: Directions for Their Preparation and Use. Pp. 20.
- No. 21. Barnyard Manure. Pp. 32.
- No. 22. Feeding Farm Animals. Pp. 32.
- No. 23. Foods: Nutritive Value and Cost. Pp. 32.
- No. 24. Hog Cholera and Swine Plague. Pp. 16.
- No. 25. Peanuts: Culture and Uses. Pp. 24.
- No. 26. Sweet Potatoes: Culture and Uses. Pp. 30.
- No. 27. Flax for Seed and Fiber. Pp. 16.
- No. 28. Weeds; and How to Kill Them. Pp. 30.
- No. 29. Souring of Milk and Other Changes in Milk Products. Pp. 23.
- No. 30. Grape Diseases on the Pacific Coast. Pp. 16.
- No. 31. Alfalfa, or Lucern. Pp. 23.
- No. 32. Silos and Silage. Pp. 31.
- No. 33. Peach Growing for Market. Pp. 24.
- No. 34. Meats: Composition and Cooking. Pp. 29.
- No. 35. Potato Culture. Pp. 23.
- No. 36. Cotton Seed and Its Products. Pp. 16.
- No. 37. Kafir Corn: Characteristics, Culture, and Uses. Pp. 12.
- No. 38. Spraying for Fruit Diseases. Pp. 12.
- No. 39. Onion Culture. Pp. 31.
- No. 40. Farm Drainage. Pp. 24.
- No. 41. Pows: Care and Feeding. Pp. 24.
- No. 42. Facts About Milk. Pp. 20.
- No. 43. Sewage Disposal on the Farm. Pp. 22.
- No. 44. Commercial Fertilizers. Pp. 24.
- No. 45. Some Insects Injurious to Stored Grain. Pp. 32.
- No. 46. Irrigation in Humid Climates. Pp. 27.
- No. 47. Insects Affecting the Cotton Plant. Pp. 32.
- No. 48. The Manuring of Cotton. Pp. 16.
- No. 49. Sheep Feeding. Pp. 24.
- No. 50. Sorghum as a Forage Crop. Pp. 24.
- No. 51. Standard Varieties of Chickens. Pp. 48.
- No. 52. The Sugar Beet. Pp. 48.
- No. 53. How to Grow Mushrooms. Pp. 20.
- No. 54. Some Common Birds in Their Relation to Agriculture. Pp. 40.
- No. 55. The Dairy Herd: Its Formation and Management. Pp. 24.
- No. 56. Experiment Station Work—I. Pp. 30.
- No. 57. Butter Making on the Farm. Pp. 15.
- No. 58. The Soy Bean as a Forage Crop. Pp. 24.
- No. 59. Bee Keeping. Pp. 32.
- No. 60. Methods of Curing Tobacco. Pp. 16.
- No. 61. Asparagus Culture. Pp. 40.
- No. 62. Marketing Farm Produce. Pp. 28.
- No. 63. Care of Milk on the Farm. Pp. 40.
- No. 64. Ducks and Geese. Pp. 48.
- No. 65. Experiment Station Work—II. Pp. 32.
- No. 66. Meadows and Pastures. Pp. 24.
- No. 67. Forestry for Farmers. Pp. 48.
- No. 68. The Black Rot of the Cabbage. Pp. 22.
- No. 69. Experiment Station Work—III. Pp. 32.
- No. 70. The Principal Insect Enemies of the Grape. Pp. 24.
- No. 71. Some Essentials of Beef Production. Pp. 24.
- No. 72. Cattle Ranges of the Southwest. Pp. 32.
- No. 73. Experiment Station Work—IV. Pp. 32.
- No. 74. Milk as Food. Pp. 39.
- No. 75. The Grain Smuts. Pp. 20.
- No. 76. Tomato Growing. Pp. 30.
- No. 77. The Liming of Soils. Pp. 19.
- No. 78. Experiment Station Work—V. Pp. 32.
- No. 79. Experiment Station Work—VI. Pp. 28.
- No. 80. The Peach Twig-borer—an Important Enemy of Stone Fruits. Pp. 16.
- No. 81. Corn Culture in the South. Pp. 24.
- No. 82. The Culture of Tobacco. Pp. 23.
- No. 83. Tobacco Soils. Pp. 23.
- No. 84. Experiment Station Work—VII. Pp. 32.
- No. 85. Fish as Food. Pp. 30.
- No. 86. Thirty Poisonous Plants. Pp. 32.
- No. 87. Experiment Station Work—VIII. Pp. 32.
- No. 88. Alkali Lands. Pp. 23.
- No. 89. Cowpeas. Pp. 15.